Entrepreneurship Potential of AI in Agriculture

21.09.2023

Jasmin Jahić

University of Cambridge, UK

jj542@cam.ac.uk

AgriTech 2023
Sarajevo, Bosnia and Herzegovina

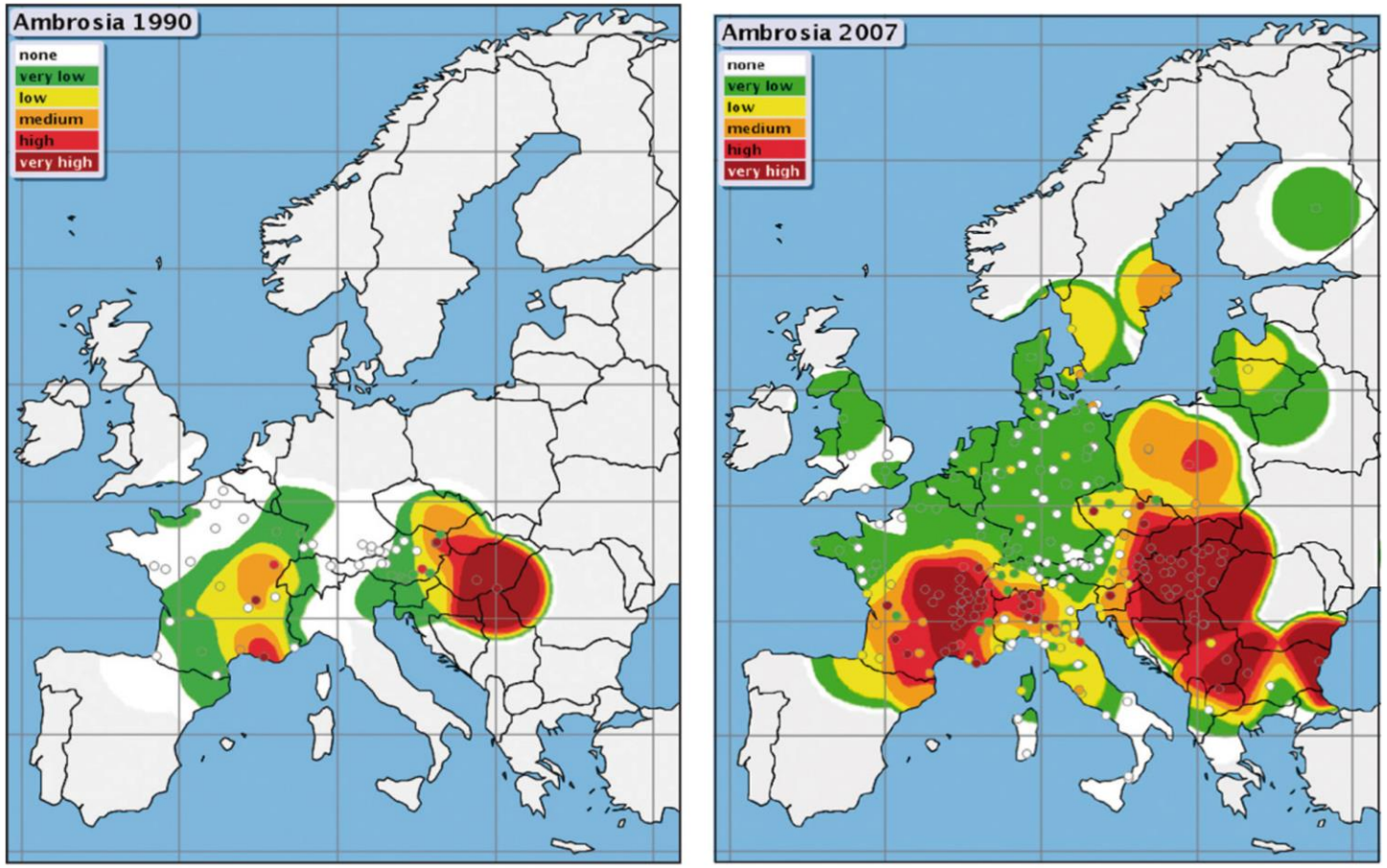
Agenda

EXAMPLES OF AI APPLICATION IN AGRICULTURE

PREDICTIONS ABOUT USING AI IN AGRICULTURE

POTENTIAL OPPORTUNITIES FOR LOCAL ENTREPRENEURSHIP

Ragweed Pollen Concentration



1990 2007

European aeroallergen network. https://ean.polleninfo.eu/Ean/

Ragweed - Ambrosia Artemisiifolia - Alergies

Common allergy symptoms:

- Nasal congestion
- Runny nose with thin, water discharge
- Postnasal drip
- Sneezing
- Coughing
- Watery, itchy or irritated eyes
- Eye swelling – the “allergic shiner”
- Weakness or fatigue
- Hives on the skin

Bavaria (Germany) and Austria, costs due to ragweed caused alergies:
- 133 Mio. EUR in 2005
- 422 Mio. EUR in 2050 (prediction)
- Sources of the costs are therapy loss of working days of allergenic persons

Richter, R., et al.: Spread of invasive ragweed: climate change, management and how to reduce allergy costs. J. Appl. Ecol. 50(6), 1422–1430 (2013)

The effort for removing ragweed:
- the cost for detection (10%)
- subsequent eradication (90%)
- For detection, a person requires 25 h/km2, 860 EUR/km2
- In Bavaria (Germany and Austria), eradication of ragweed is estimated to be 8570 EUR per km2 in total.

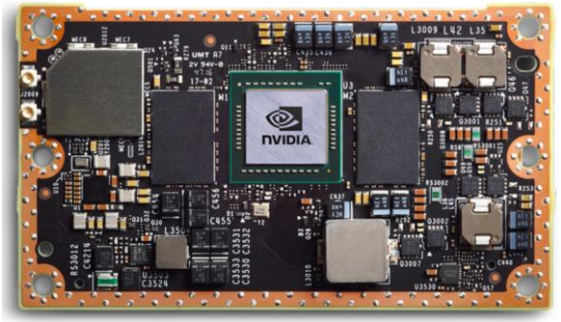
Study of DNN-Based Ragweed Detection from Drones, Martin Lechner, Lukas Steindl, Axel Jantsch, SAMOS 2022

Aerial drones equipped with highly compressed deep neural networks (DNNs) to scan large areas of vegetation for ragweed with high speed and precision

DJI Phantom
£1589 (3612 BAM)

DJI Matrice
£8050 (18 300 BAM)

WingtraOne
£16000 (36 374 BAM)



Nvidia Jetson TX2
£350 (800 BAM)

Scenario S1: detect small ragweed (10 cm in size)
Scenario S2: detect large ragweed (1 m in size)

For detection, a person requires 25 h/km2
Manual survey approach: roughly 860 EUR/km2

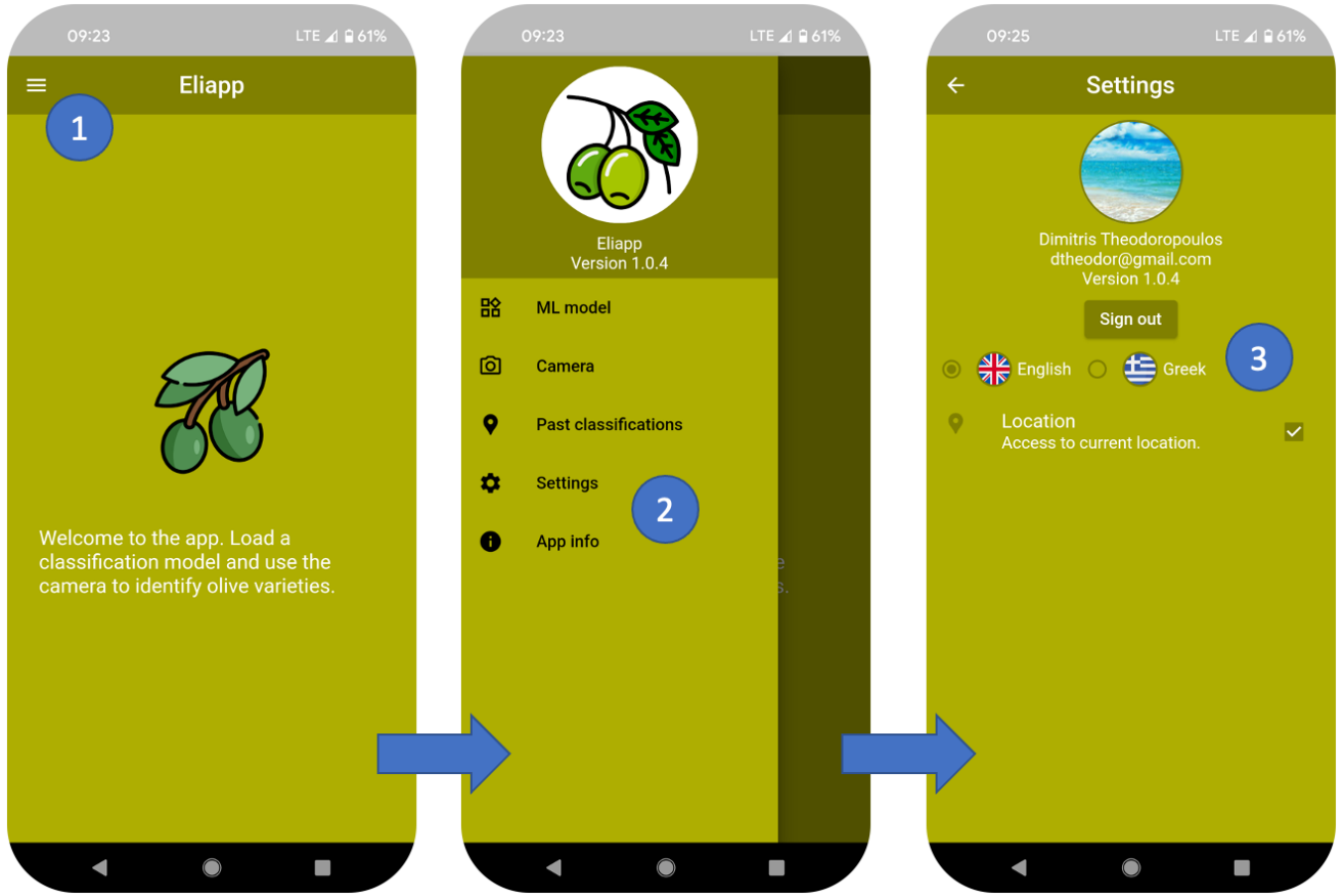
Scenario	**S1**			**S2**		
Drone	DJI Phantom	DJI Matrice	Wingtra One	DJI Phantom	DJI Matrice	Wingtra One
Time [h/km2]	2.54	1.48	3.19	0.26	0.15	0.31
Costs [EUR/km2]	152.3	176.9	145.6	15.2	17.7	14.6

ELAION: ML-based System For Olive Classification With Edge Devices, Dimitris Theodoropoulos, Konstantinos Blazakis, Dionisios Pnevmatikatos, and Panagiotis Kalaitzis, SAMOS 2023

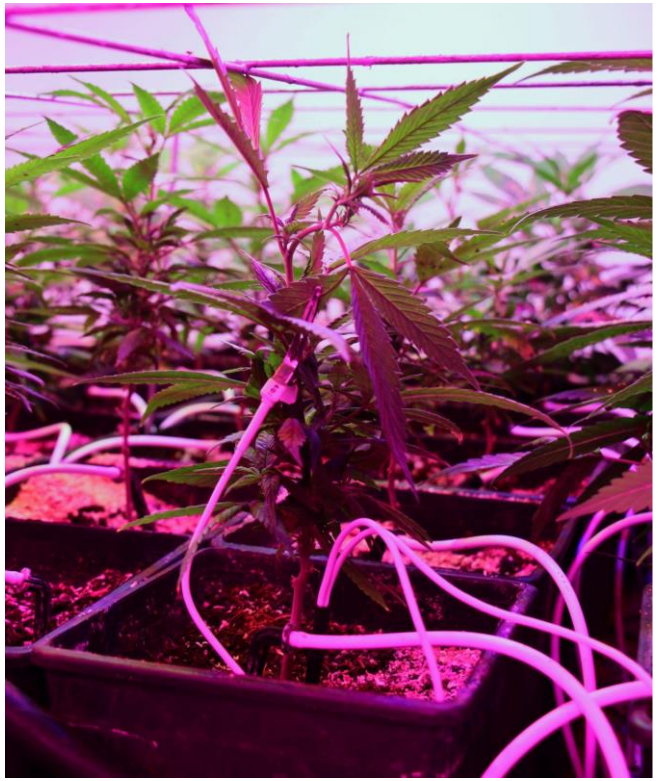
On-site olive classification for olive growers

Can classify 25 different olive varieties

The project was co-financed by the Special Managing and Implementation Service in the areas of Research, Technological Development and Innovation (RTDI) - Greece, and the European Union.



Agriculture 4.0: Smart Farming



Research Studios Austria - Smart Greenery: Medicinal Plants and the Vertical Farmin
https://www.researchstudio.at/approaching-agriculture-4-0-smart-farming-in-lower-austria/?lang=en

Electronic Components and Systems (ECS) Strategic Research and Innovation Agenda (ECS-SRIA) - https://ecssria.eu/

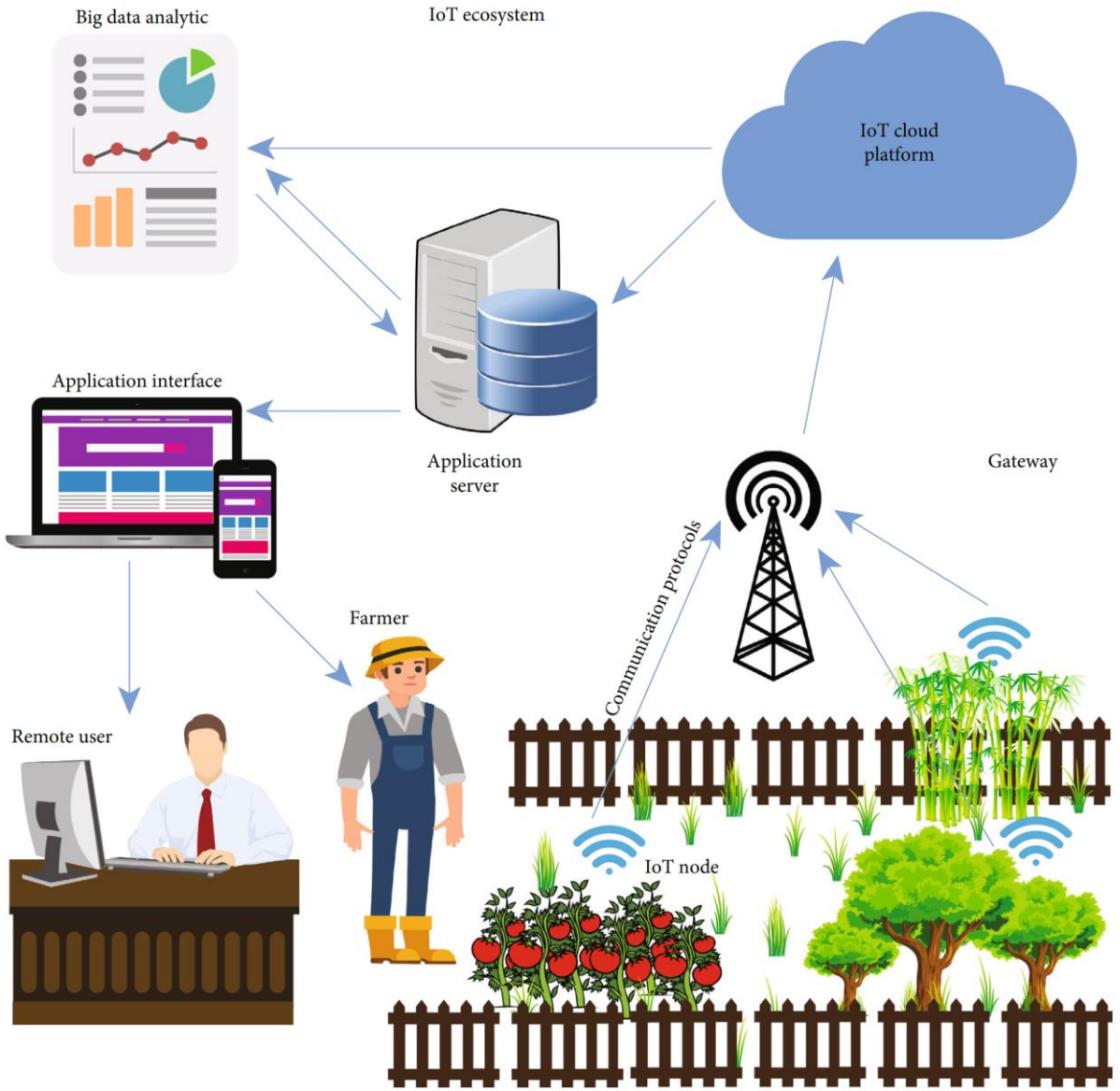
- Agrifood And Natural Resources
  - Food Security
  - Environmental protection and sustainable production
  - Water resource management

Intelligent food production systems

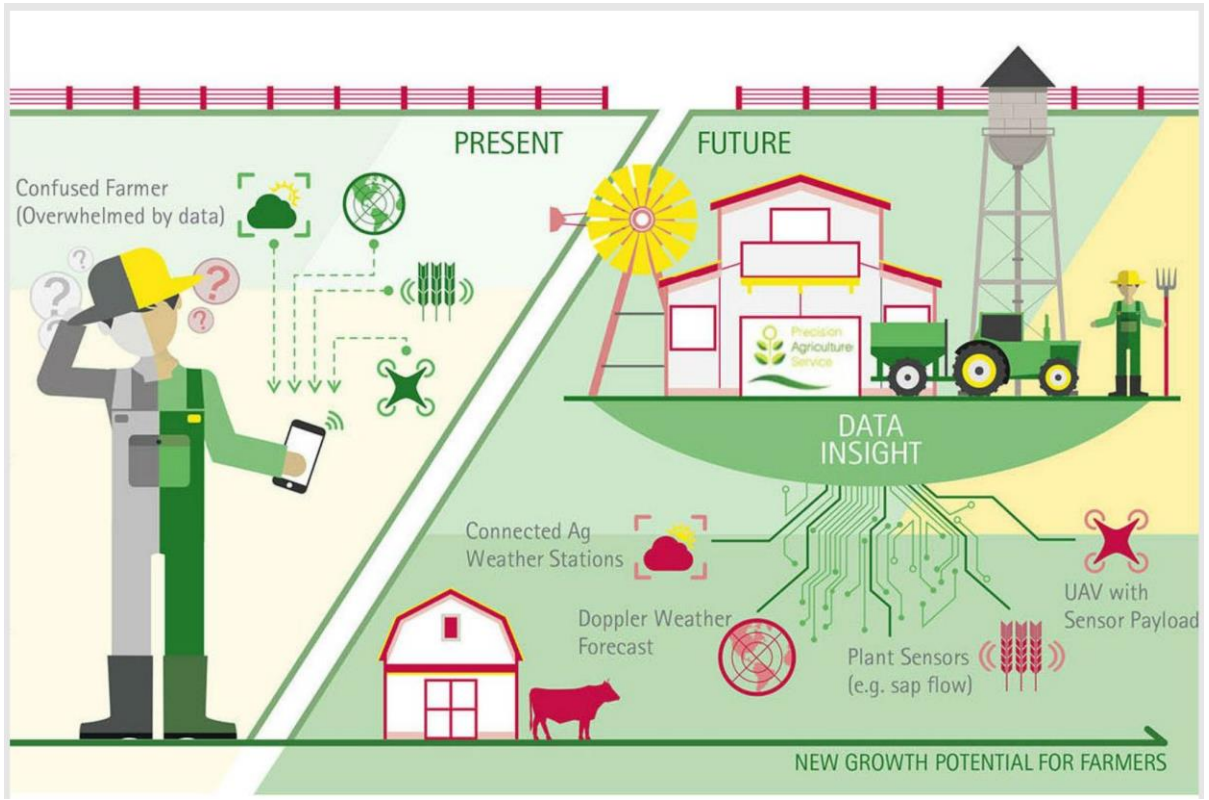
- AI/machine learning (ML) - intelligent decision-making for greater energy efficiency.
- Tailor-make new products to help cope with ever demanding diets.
- Smart workflow to manage, monitor, optimise and automate all processes accordingly (in-line inspection, networked packaging systems and robot technology)

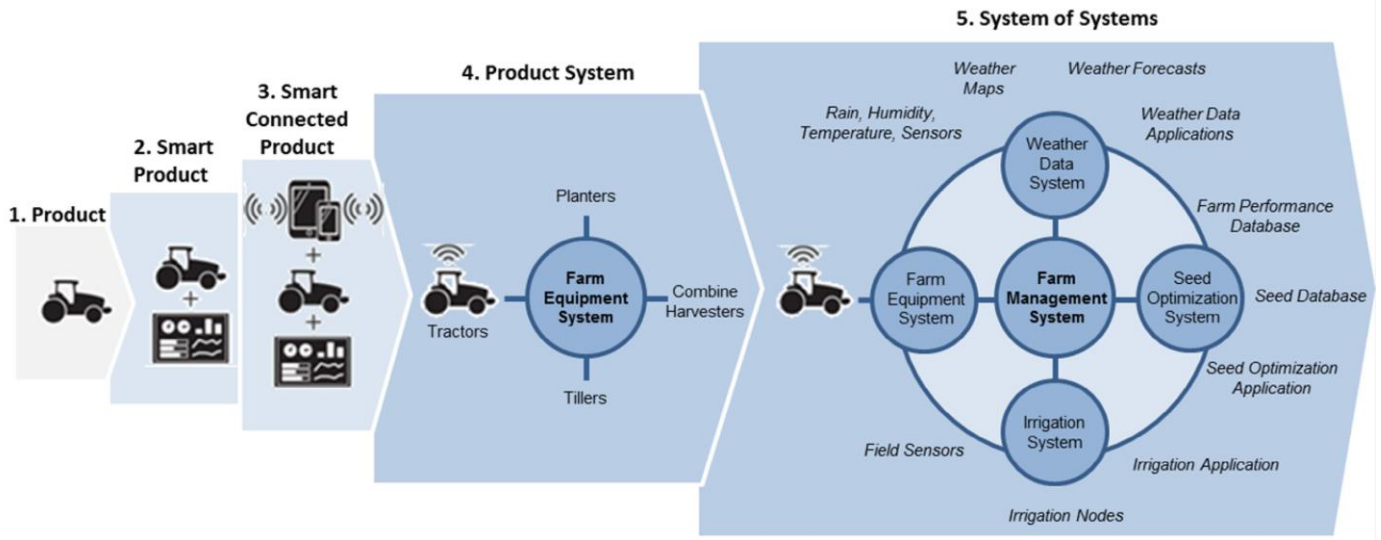
Farms in (near) future?

Taimoor Qureshi, Muhammad Saeed, Kamran Ahsan, Ashfaq Ahmad Malik, Emaduddin Shah Muhammad, Nasir Touheed, and SK Hafizul Islam. 2022. Smart Agriculture for Sustainable Food Security Using Internet of Things (IoT). Wirel. Commun. Mob. Comput. 2022



Industry 4.0 in agriculture: Focus on IoT aspects, 2017 - https://ati.ec.europa.eu/sites/default/files/2020-07/Industry%204.0%20in%20Agriculture%20-%20Focus%20on%20IoT%20aspects%20%28v1%29.pdf

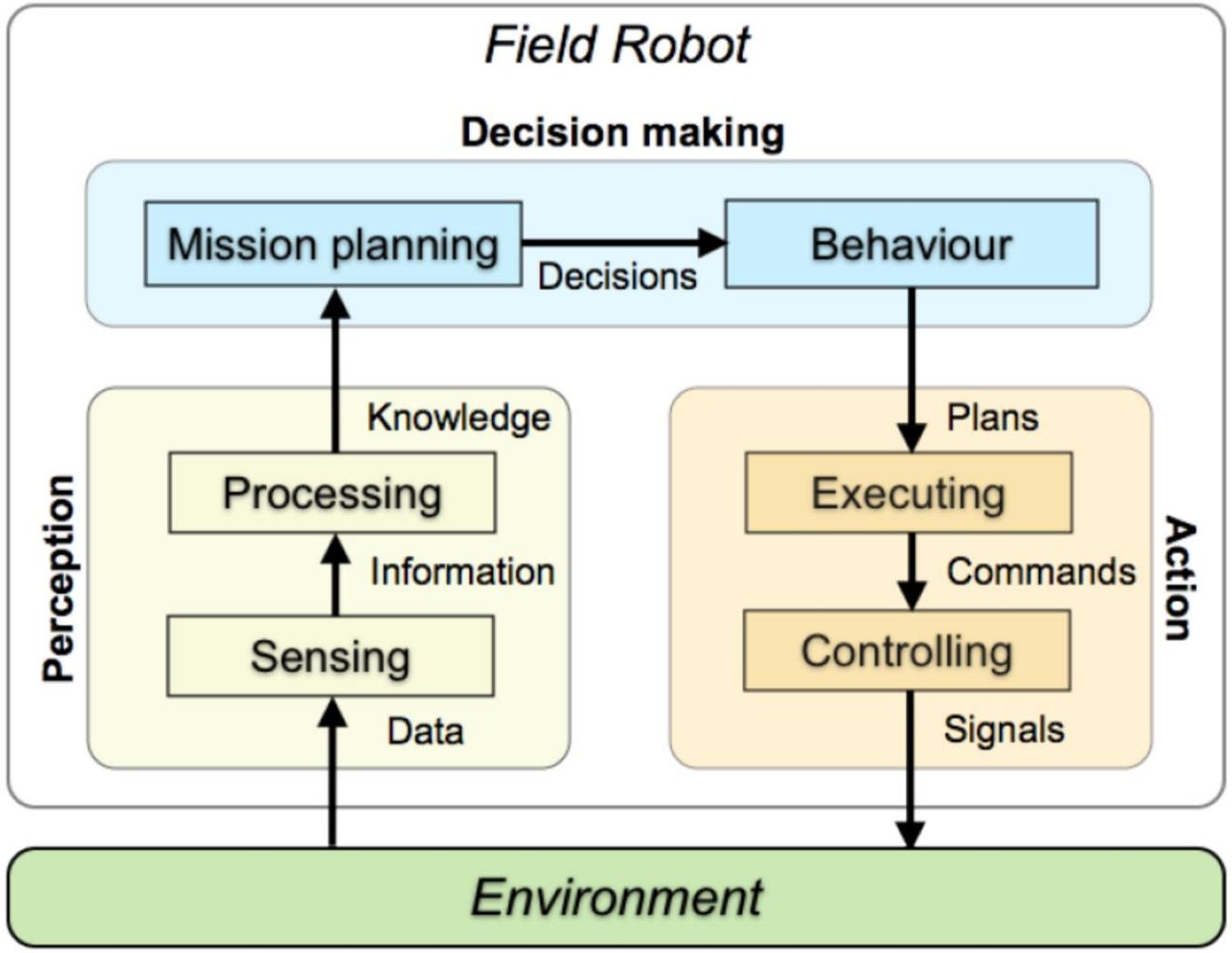




Jensen K, Larsen M, Nielsen S, Larsen L, Olsen K, Jørgensen R. Towards an Open Software Platform for Field Robots in Precision Agriculture. Robotics 2014;3(2):207–34

Scouting the Autonomous Agricultural Machinery Market; Jörg Dörr, Bob Fairclough, Jens Henningsen, Jasmin Jahić, Stefan Kersting, Patrick Mennig, Christian Peper, Friederike Scholten-Buschhoff, 2019 - https://www.iese.fraunhofer.de/content/dam/iese/dokumente/innovationsthemen/scouting_the_autonomous_agricultural_machinery_market-en-fraunhofer_iese.pdf

- Obviously, we need data, a lot of data, in real-time
- Once we have data, AI can do the following

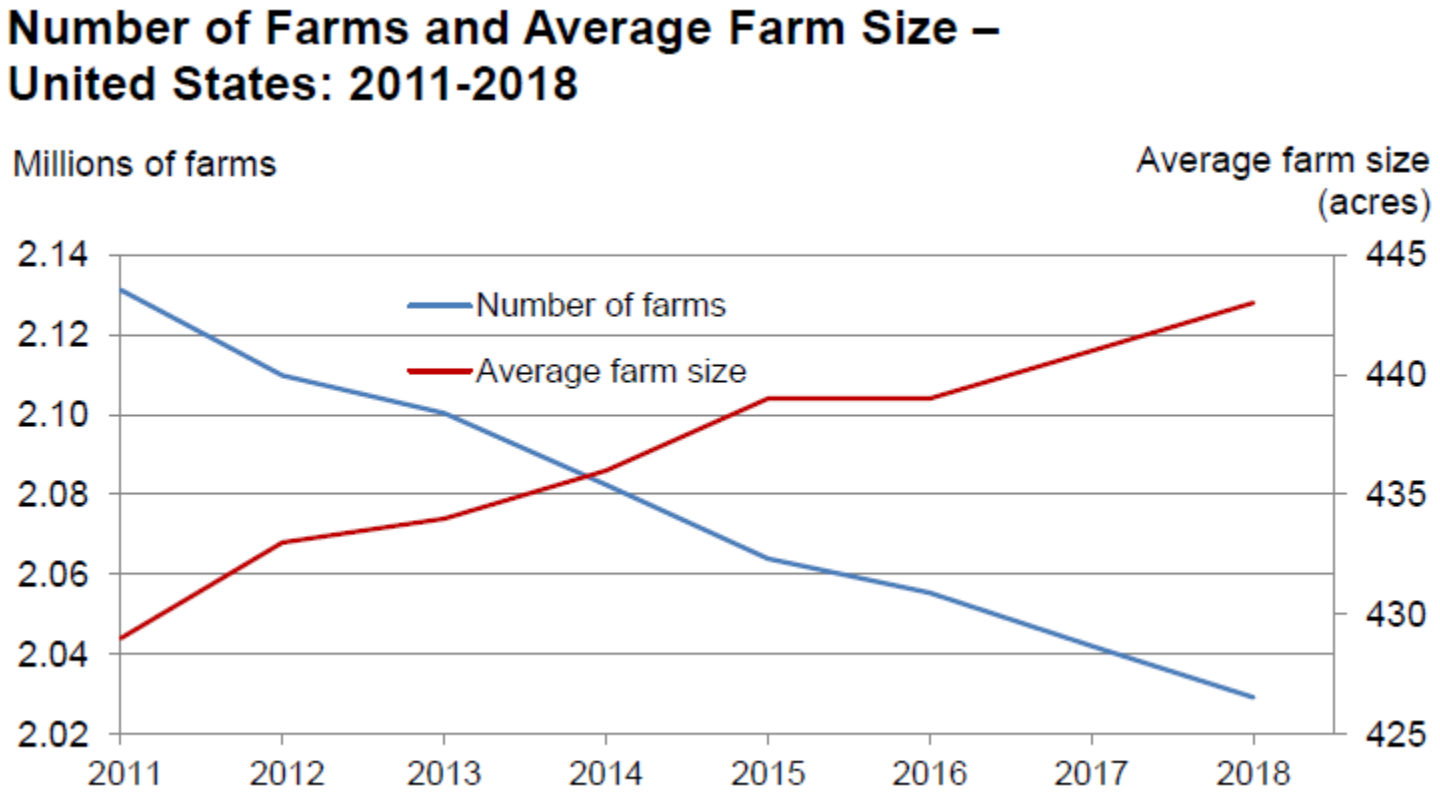



32%
53%
12%
3%


Spray 95%


AUTONOMOUS

Predictions about using AI in Agriculture



USDA, National Agricultural Statistics Service. Farms and Land in Farms 2018 Summary 04/18/2019. Available: from: https://www.nass.usda.gov/Publications/Todays_Reports/reports/fnlo0419.pdf

Challenges with adopting AI in Agriculture

- Reasons for not adopting driverless tractors, agricultural crop picking robots, and UAV's
  - Inability to generate trust - a human not aware of on-farm activities
  - Loss of farming knowledge - machines take over a range of operations
  - Reduced social cognition - cognitive risks regarding enterprise perception, knowledge and understanding

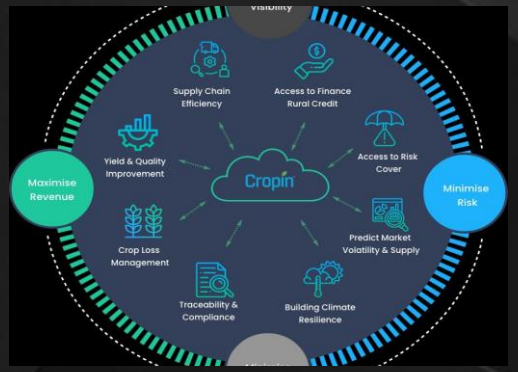
Devitt SK. Cognitive factors that affect the adoption of autonomous agriculture. Farm Policy Journal 2018;15(2):49–60.

Scouting the Autonomous Agricultural Machinery Market; Jörg Dörr, Bob Fairclough, Jens Henningsen, Jasmin Jahić, Stefan Kersting, Patrick Mennig, Christian Peper, Friederike Scholten-Buschhoff, 2019 - https://www.iese.fraunhofer.de/content/dam/iese/dokumente/innovationsthemen/scouting_the_autonomous_agricultural_machinery_market-en-fraunhofer_iese.pdf

Potential Opportunities for Entrepreneurship

- Startups
- Medium and large companies
- Research and development (universities and research institutes)
- Governments (global competition and local development)

Startups

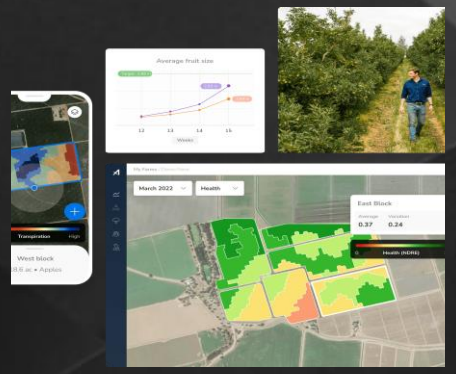


Cropin - India

Farm-Businesses with farm management software and mobile apps, which enable them to do connected, and data driven farming.

http://www.cropin.com/

Funding: $46.4M



Aerobotics - South Africa

A data analytics company, using aerial imagery and machine learning algorithms to help farmers identify pest and disease early.

https://www.aerobotics.com/

Funding: $27M

Carbon Robotics – USA

High-resolution cameras to distinguish between weeds and crops in real-time. Precision weed control through an array of high-powered lasers regardless of weather or time of day.

https://carbonrobotics.com

Funding: $65.9M

Startups

- https://www.ai-startups.org/
- https://www.kickstarter.com/
- Can we make autonomous robots?
- It is a complex system of systems, and there is a need for many parts

Medium and Large Companies

- What are the needs? What does the technology need to solve?
- Customized and optimized solutions
- Many challenges and a lot of potential
  - Organic
  - Minimise resources
  - Minimise the impact
  - Climate change
- Example: Which apples are good for jam and which for syrup?

Research and development (Universities and Research Institutes)

Interdisciplinary research

- What does the technology need to solve?
- Technology solutions often exist, but those building technology are not aware of its potential

Research and prototypes

- Cutting edge innovation
- Education
- Start-ups culture

Agrifood And Natural Resources - https://ecssria.eu/3.5

- The ECS-SRIA describes the major challenges and priorities, and the necessary R&D&I efforts to tackle them, in the area of the electronics components and systems, and systems of systems, spanning the entire ECS value chain, from foundational and cross-sectional technologies to application fields.

Government

Local development

Sustainability

Empowerment

Global impact

Some Ideas…

- Allergy costs in Bosnia and Herzegovina?
- What is the impact of the climate change on traditional agriculture?
- Can we grow in-door exotic fruits and vegetable?
- Large-scale management of farms and agricultural fields
- Mapping in Bosnia and Herzegovina: topology vs agriculture (what kind of plants grow where, why?)
- Which apples are better for jam and which for syrup?
- Industry of small drones
- Sensors and data processing devices

What can we do?

Identify problems from everyday life

Get in touch with established home industries and industries abroad

Small steps to first prototypes

Research projects at universities

Prototypes for industry

Grants to support startups

Conclusion

The time is ripe for AI in agriculture

Many challenges – we will probably not and we probably do not want to exclude people from the loop

- But, we want to support them to make informed decisions

Huge potential for startups – from data collection to small systems to be a part of an eco-system, to big systems that need to scale

Questions?

Ideas?

Collaborations?

jj542@cam.ac.uk

https://jahic.github.io/